Sandia National Laboratories

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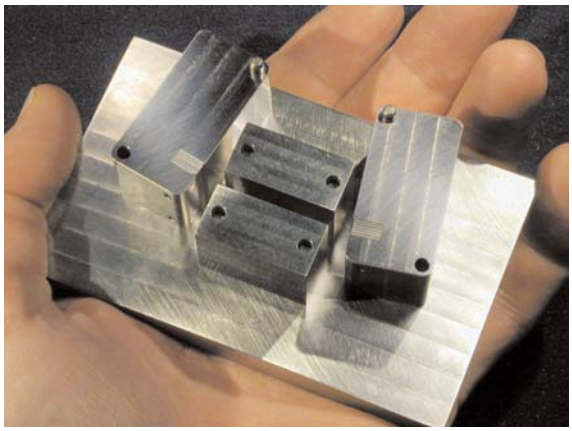
Novel Approach To Bonding PSZT Elements

A new current stack bonding technique has been developed to eliminate voids in the epoxy joints and to reduce cycle time. Current stack design requirements limit bond line thickness and define an upper limit for void size within the bond joints.

Our current method of bonding these elements uses a two-part epoxy, which contains a small amount of a silica thickening agent. This silica-loaded epoxy is thoroughly mixed, with care taken to avoid the creation of bubbles, and then a 0.001-0.005 inch layer is applied to each bonding face. Despite meticulous efforts to level the epoxy, air is trapped when the coated elements are placed together. The trapped air pockets, along with bubbles in the epoxy, form voids in the bond line. After epoxy application, fixturing is used to squeeze the stack to remove excess epoxy and form thin bond lines. However, large silica agglomerates present in the epoxy can prevent adequate epoxy squeeze-out, resulting in unacceptably wide bond joints.

With the help of the Organic Materials Department and the Mechanical Engineering Department, Sandia has developed a new immersion/infiltration technique to avoid the formation of bubbles and the trapping of air in the epoxy joints. The Mechnical Engineering Department developed fixturing that provides an epoxy chamber and indexing so that the elements can be separately immersed into the epoxy pool. This technique takes advantage of capillary action to permeate the joints with epoxy, thus displacing air ahead of the epoxy front. The Organic Materials Department provided a lower viscosity, unloaded epoxy that readily flows between the indexed elements. Since the unloaded epoxy is agglomerate-free, stacks made by this technique have very thin bond lines. Completeness of joint fill has been verified by through-transmission ultrasonic analyses.



Fixturing developed by the Mechanical Engineering Department

This new technique is faster and produces joints that meet design requirements. Bonding of current stacks will now take place in teams, where stacks are bonded in a parallel fashion rather than one at a time. A time saving of 30% is expected. WR qualification of this process is underway and will include explosive functional testing, the most stringent requirement.

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Advanced Manufacturing LDRD Investment Area

The Advanced Manufacturing LDRD (Laboratory Directed R&D) Investment Area supports Sandia's missions by advancing both the capability to fully understand and model manufacturing processes and the development of new processes and techniques to make product. The Center defines manufacturing as the science, technology and processes to create and manage product throughout its life cycle. The Adv. Mfg. LDRD investment area is focused on two technical areas that are critical for the present and future missions of Sandia. These areas are (1) manufacturability and (2) rapid product development.

Manufacturability is the interplay between design, fabrication processes, and the constraints of the environment, cost, and quality. Furthermore, a product is designed with “manufacturability” in mind, when the manufacturing processes are included as an integral part of the design process, such that the product can be fabricated to meet functional requirements the first time and every time. In the low volume, high reliability, high consequence manufacturing niche that is unique to the majority of manufacturing (both prototyping and production) needs at Sandia, “manufacturability” is critical to success. LDRD projects in this area emphasize a basic understanding of the S&T underpinnings of physical and chemical systems that can be applied to manufacturability. Sometimes, the LDRD project may focus on demonstration of prototype functionality.

Another important driver for manufacturing at Sandia is the need to go quickly from concept to prototype to production. Several recent studies have highlighted a need for reduced cycle time in product design, fabrication, and qualification. Additionally, the quick transitioning of R&D concepts into the manufacturing sector has become a pressing national issue identified in the many Homeland Security

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Tech Updates

LTCC Fabrication Techniques Improve Micro System

Low **T**emperature **C**ofired **C**eramic (LTCC) is applicable to a broad range of micro systems. In particular, the ability to customize processing order and material choices on LTCC has enabled new features to be constructed. Unique shapes in LTCC permit the simplification of complete systems, as in the case of a miniature ion mobility spectrometer (IMS, Fig. 1). In this case a rolled tube has been employed to provide hermetic external contacts to electrodes and structures internal to the tube. This replaces the dozens of fragile individual pieces and delicate connections in the previous system. New LTCC techniques for micro-IMS fabrication have improved function and increased ruggedness while simplifying the structure for better manufacturability at lower cost, which is critical to widespread implementation of robust sensing capability.

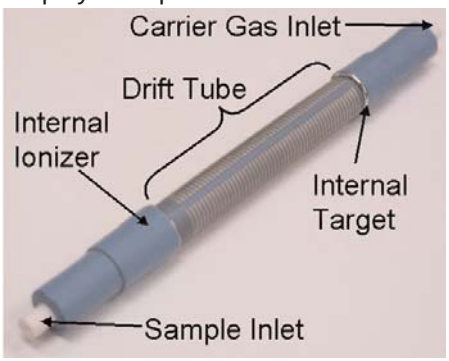

Fig. 1. A miniature ion mobility spectrometer

A drift tube is fabricated by rolling unfired glass-ceramic tape with thick film features on both sides, including internal electrodes, external connections, seal rings, a buried heater, and an integral precision resistor network (Fig. 2). The tube supports itself mechanically through burnout and firing. The assembly of internal components, including an ionizer, apertures, grids, and a target, is accomplished from the tube ends. The high aspect ratio of LIGA grids accomplishes low obstruction with high axial rigidity. Gas plumbing is also incorporated, and a sacrificial material technique that simplifies the exhaust porting is utilized.

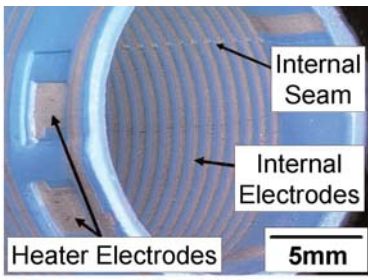

Fig. 2. Internal and external details of drift tube.

Prototypes have detected ion peaks in laboratory trials and the design is currently undergoing final testing.

This project has been an example

(LTCC, Continued, page 4)

Manufacturing Enterprise Produces Hardware for Environmental Qualification Test

The Manufacturing Enterprise (ME) recently teamed with the Advanced and Exploratory Systems Department to fabricate prototype hardware that will be used as a payload in the Environmental Qualification Test for the High-G program. The program uses the sled track in New Mexico to propel a 5000-pound penetrator into a concrete target containing over 400 cubic yards of concrete.

There are three primary decks with supporting hardware that will be used to house experiments. The experiments include a MEMs experiment, two 12-channel AdPen data recorders, and an RF telemetry experiment. The MEMs experiment is a passive experiment that will provide insights into MEMs designs and mounting techniques. The data recorders will capture acceleration and strains on the penetrator case during the penetration event. Finally, the RF telemetry experiment will broadcast acceleration real-time during the penetration event. Designing and manufacturing rugged housings will ensure the success of each experiment.

By manufacturing this project in-house and being co-located with the design group, engineers and the ME were able to order material and begin fabrication of hardware before designs and drawings were finalized. This "engineering on the fly" technique reduced the time to complete the final prototype hardware. The intent was to save time by doing concurrent engineering and design while parts are being manufactured. Also, when processing issues arose, the machinists working on fabricating hardware would call the customer and make manufacturability recommendations, which often resulted in in-process design changes.

One particular example of an in-process design change was to the Deck 2 EQ housing where a through slot had been defined as being at an acute angle to the axis of the unit (geometrically constraining location). Manufacturing of this slot would have required a complex wire EDM work holding fixture. The customer was notified and immediately reviewed the design. An alternate path forward was defined—resulting in no loss of manufacturing time. Fit checks of mating parts (both fabricated and purchased) were made during the manufacturing process to ensure field alignment.

The Manufacturing Enterprise is looking forward to continuing and growing this partnering relationship with the Advanced and Exploratory Systems Department.

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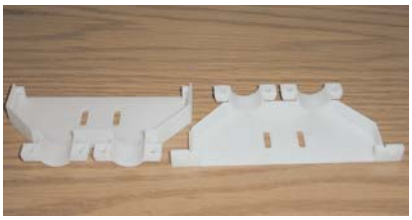
Design to Application Potting Shells

The Center is currently designing custom-fit potting shells for its cable customers that are manufactured using a completely paperless process. The part is designed using SolidWorks 3D Modeling software, and the electronic files are provided to our Rapid Prototyping personnel in the Mechanical Engineering Department to manufacture the parts. This is a significant improvement over the previous method of machining a mold master for casting a low melting temperature metal, plating over the surface of that cast part to get the thickness needed for the shell, and then melting out the low temperature mold.



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Insider News

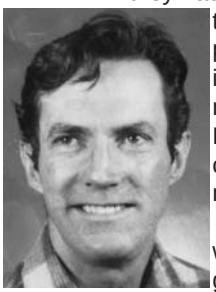
Donald L. Greene Retires After 43-Plus Years

Don graduated from Mountainair High School in 1956 and joined the U. S. Navy only two weeks later.

Don was hired into the Machinist Apprentice program at SNL on August 29, 1960. Upon graduation in 1964, he was rotated through all areas of the machine shop from the Miniature to the Heavy Machining sections, including the Numerical Control Programming section.

Donald L. Greene

From 1977 through 1985, he was a Machine Shop Theory instructor for the Machinist Apprentice Program. There he provided full training for 24 trades over the course of their 4- year apprenticeship. In 1986 he was assigned to the mechanical engineering group, working on components, which included StrongLinks, MSAD, DSSL, Rolamites, Capacitors, and Pull-Out switches. The capacitor work involved winding and assembling Liquid Filled, Gel Filled, and Dry Wrap and Fill capacitors. During this time he also helped design and maintain closed loop computer aided winding machines.



Don's 1964 "sign-in" photo

In 1995, he helped develop the LENS (Laser Engineered Net Shaping) system, assisting in the design, assembly, and maintenance of the system. Don Greene and Lane Harwell built the first LENS machine out of recycled and salvaged parts. The Robotics Deptartment provided $30K in funding for stages. By Oct. 1995, they had successfully fabricated the first thunderbird using the LENS process, although Don admits that it was an ugly one. This new technology led to the formation of a LENS consortium that consisted of Sandia and 10 industrial partners and a 5-year CRADA.

From 2002 on, Don has been working with various satellite programs, helping to design tooling and fixturing. Don was part of the team responsible for meeting several corporate milestones on the EnRad program, which was the highest density 3-dimensional integrated circuit ever built. The successful completion of the EnRad program led to the follow-on BDYE program, on which Don helped to develop a novel attachment technique.

Employees Outside Work—Manny Trujillo

Music has always been a part of Manny Trujillo's life. He has been singing and playing in a Mariachi Band for 7 years and has released 3 musical CDs. Manny grew up in Los Chavez, NM and has worked at Sandia for almost 25 years. He currently works in the Organic Materials Department, where he specializes in encapsulation using a variety of resin systems for NW components. Manny also works on production and packaging of neutron generators, bonding of penetrators, and interfacing with SNL suppliers. Manny is married to Marcelle Trujillo, and has a son, Christopher, who is in the U. S. Navy and currently stationed in San Diego.

Manny says that he's always loved music. "When I was a kid, Mom knew I was OK if I was singing in the background. I've sung for as long as I can remember. My grandfather used to play a lot of instruments."

After Manny had played in a variety band for about 8 years, Isidro Molina, a brother-in-law, asked him to join their Mariachi group because they needed a vocalist. Manny sings and plays the guitar and the Q-chord (used for other types of music). His Mariachi group plays mostly at private parties. The band has 5 people from Sandia: Roque Gallegos, Isidro Molina, John Guillen, Rudy Jaramillo and Manny. They feature vocals, guitars, guitarron (bass), 2 violins, and a vihuela.

Manny's CDs include one variety (Spanish/English/rock), one Mariachi, and one Christian. Most of the members of the group played on the last two.

Aside from his work and music, Manny also enjoys working on his yard, carving figurines in alabaster, participating in church activities, and bowling. "I love to dance," he proclaims. "We used to play in a band where we would play four one-hour sets and I'd dance with Marcelle during the 15 minute breaks. I like to listen to different types of music depending on my mood. But I like to crank up the Mariachi!"

Computer Security Reps—The Center's Resource

Bill Hughes, the Mfg S&T Center's primary Computer Security Representative (CSR), and Ron Ward, his alternate, have been making a series of presentations to departments about the roles and responsibilities of all personnel in building and maintaining a secure computer environment, and their roles as resources to the Center.

The CSR assists line organizations with understanding and implementing classified and unclassified computer security programs in a manner that meets mission objectives. They have limited authority delegated by Information Systems Security Site Manager (ISSM). They assist in the preparation of computer security plans for the Center, which has about 40 classified standalone PCs or lab equipment. They are knowledgeable about the correct procedures for maintaining a proper classified environment, such as requirements for two-person control, incompatible media, removable hard drives, and special locks and devices for access control. They also define and train personnel in the procedure to change modes.

Bill Hughes

Computer security plans must be resubmitted/updated whenever there is a change in primary operator, location or equipment or, at the least, every three years.

The CSRs also review and approve policies concerning contractor/visitor computers, which must have no network connection, no classified material or access, and no video, audio, or RF capability activated. Otherwise the computer must be referred to the Computer Security Department (CSD). The CSRs also review and approve Foreign National visits and their access to SNL computer resources.

The CSRs assist in the Center Information Plan (CIP), which must be revised and updated annually. This plan specifically defines the types of information in the Center; identifies important information systems; and identifies exceptions to master/standard security plans.

Center personnel can assist the CSD's external inspections and audits by performing internal audits, self-assessments and risk assessments; by working to resolve identified concerns; and by maintaining continuous improvement. They should also review master security plan changes for impacts on the Center.

The CSRs also strive to increase awareness of Computer Security with employee meetings, emailed special announcements, and ad hoc consulting. Their advice is to plan ahead, as security plans take time to implement. Their motto is "When in doubt, consult!" as doing it alone can lead to many unnecessary problems.

(LTCC, Continued from page 2)

of good cooperation and communication across a broad range of technical aspects involving a number of organizations in Mfg. Science and Technology and Microsystems Science, Technology and Components: Ken Peterson, Steve Rohde, Kent Pfeifer, Kevin Linker, Tim Turner, Tom Lemp and Doug Adkins.

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New Permanent Employees

Name	Org
Anderson,Steven C.	14112
Borrego,Therese D.	141121
Myers,Devan K.	141121
Jaramillo,Rex K.	141721
Galloway,Jeffrey A.	14172
Klein,Patrick J.	14172
Hill, Charles T.	141812
Smith, Cameron T.	141812
Tomlinson, Kurt	141812
DiAntonio,Christopher B.	14192
Abeyta-Salazar,Victoria	14192

Mfg S&T Newsletter Contacts

14100	Carol Adkins
14100	Carla Chirigos
14112	Debbie Duran
14171	Kim Archuleta
14171	Rose Torres (in transition)
14172	Heidi Ruffner
14181	Daryl Reckaway
14184	Ed Wyckoff
14186	Linda Kelton
14192	Julie Marquez

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND2004-0477P

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studies done following the tragedy of 9/11/01. New technologies and processes that enable rapid product development and transfer to production are of value to all Sandia's Strategic Management Units (SMUs).

As part of a corporate-wide LDRD process, proposals submitted to the Adv. Mfg. investment area from across Sandia are reviewed by a team of managers representing all of Sandia's SMUs, as well as technical experts from other SNL organizations. Projects are chosen that are expected to impact manufacturing at Sandia, are creative and innovative, have a scientific basis, and have potential application to the national manufacturing community. Every year, the process begins again in early spring to collect ideas for the technologies of the future.

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What is the ME?

The ME is an acronym used for the Manufacturing Enterprise. The Manufacturing Enterprise is a title that came into existence in 1998 and describes two departments that jointly decided to pursue ISO 9000 registration. The ME successfully achieved registration to the International Standard back in April 2000. There were only two departments at that time in the ME, Manufacturing Processes and Services Department; and the Manufacturing Processing Department. Now the ME has expanded to include the Computer Applications for Manufacturing Department.

The Manufacturing Enterprise has a documented quality system and is registered by the Performance Review Institute in recognition of a quality system demonstrated in conformance with ISO 9001:2000. Paul McKey, ISO Management Representative, feels the decision to go ISO and the process of getting there has been very beneficial to the ME's business. One of the concepts in ISO is continual improvement, and the ME has put processes into place that facilitate system improvements.

What is the distinction between the ME and the Mfg S&T?

The Mfg S&T is an acronym for the Manufacturing Science and Technology Center. The Center contains nine organizations. The ME is part of the Manufacturing Science and Technology Center. The ME comprises 47% of the employees of the Center and is responsible for a significant portion of the work that is performed within the Center.

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